by engiNUity
Northwestern University
Solar Decathlon Design Challenge 2021
Urban Single-Family Home
The Challenge

LOCAL

Narrow Site Footprint

Typical Chicago Lot

25' x 125'

Lack of diverse housing options

Need for relocation

Difficult Climate for Net-Zero Construction

Sustainable Homes not widely available

Climate Change

Narrow Site Footprint
The Challenge

Difficult Climate for Net-Zero Construction

Narrow Site Footprint

Typical Chicago Lot

25' x 125'

REGIONAL

LOCAL
The Challenge

- Global
- Regional
- Local

Narrow Site Footprint

- 25' x 125' Typical Chicago Lot

Difficult Climate for Net-Zero Construction

Cost of Sustainable Development
Our Goal

MARKETABLE SUSTAINABILITY

Financial Feasibility
Efficient Construction Future-Proof

Healthy Living
Open Living Natural Light Nature Indoors

Resiliency & Versatility
Family-Responsive Durable Diverse Housing

Environmental Consciousness
Net-Zero Reduce Consumption Strengthen Neighborhood

Healthy Living

Nature Indoors

Strengthen Neighborhood

Resiliency & Versatility

Diverse Housing

Financial Feasibility

Efficient Construction Future-Proof

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Net-Zero Reduce Consumption Strengthen Neighborhood
2326 sq ft
Main Home (1766 sq ft)
2 bed
2.5 bath
2 car garage
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2 bed
2.5 bath
2 car garage

ADU (560 sq ft)
1 bed
1 bath
ADU (560 sq ft)
1 bed
1 bath

Main Home (1766 sq ft)
2 bed
2.5 bath
2 car garage

2326 sq ft

EUI: 12
HERS: -22
Function

3rd Floor

2nd Floor

1st Floor

NUHOME

ARCHITECTURE
PASSIVE DESIGN
WATER SYSTEMS
ENERGY ANALYSIS
COST
EXPERIENCE

Northwestern McCormick School of Engineering
Form

BUILDING SHAPE

- Basic Box
- Box w/ Void
- C-Shape

ADU LOCATION

- Garden Level
- 1st Floor
- 1st & 2nd floors
- Detached

ROOF

- Flat
- Pitched
- Sloped

Square Footage, Thermal Envelope

Efficiency, Accessibility

PV Compatibility
Form

BUILDING SHAPE

Basic Box

1st Floor

ADU LOCATION

ADU

N

Main House

S

Sloped

ROOF

ARCHITECTURE

PASSIVE DESIGN

WATER SYSTEMS

ENERGY ANALYSIS

COST

EXPERIENCE

Northwestern McCormick School of Engineering
Thermal Envelope

- 6" EPS
- 12" DP Cellulose
- Class III Vapor Barrier
- Liquid Weather Wrap
- 12" DP Cellulose
- 2x4 Double Stud
- No Rim Joist
- Thermal Bridging
- 6" EPS “Slab” Structural Fill
- Frost-Protected Shallow Foundation
Water Core

Manifolds

Greywater and Cold Water to Backyard Drip Irrigation

Sewage Line

City Water Main

Greywater System

Hot Water Manifold

Drain Heat Recovery Unit

Moss Wall 1

Moss Wall 2

Moss Wall 3

Cold Water Manifold

Energy Analysis

Water Systems

Cost

Experience

Passive Design

Architecture

NU Home

McCormick School of Engineering
Greywater Reuse

-65%

Flush Fixture

-16%

Landscaping
Water Savings

60.5% Reduction Overall

60-Year Savings: $34,474.40
Key Energy Saving Features

- **Envelope**: R-37, ACH 0.5
- **Heat Pumps**: R-62
- **Appliances**: Energy Recovery, Appliances, Appliances

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**NU Home**

**Architecture**
**Passive Design**
**Water Systems**
**Energy Analysis**
**Cost**
**Experience**

Northwestern McCormick School of Engineering
HERS and EUI

Benchmark Residential Building

BUILDING EUI (kBtu/ft²/yr)

100 → 31

HERS without PV
11.3 kW Solar + Microinverter

1st-year Generation:

14 MWh

HERS with PV:

-22

NUHome:
Functions off-grid for 65% of daytime hours.
Meets 43% of load from on-site PV during peak times.
Annual Living Expenses

Annual Living Expenses of NUHome vs. Typical Home

Typical

$6,092 / year

Yearly Cost of Living

$3,388 / year
Long-Term Living Expenses

Cost of Typical Home of Same Square Footage and Cost of NUHome

- Net Cost: $248,280
- Net Cost: $725,494

Cost Analysis:
- Construction cost
- Living expenses (60 years)
- ADU income (30 years with tenant making $50,000 per year)
Aging in Place

Just Married
Age: 30

Riya

Enzo
Aging in Place

Just Married
Age: 30

Growing Family
Age: 35
Aging in Place

Just Married
Age: 30

Growing Family
Age: 35

Extra Income
Age: 40
Aging in Place

- **Just Married**  
  Age: 30

- **Growing Family**  
  Age: 35

- **Extra Income**  
  Age: 40

- **Empty Nesters**  
  Age: 65
EXPERIENCE
PASSIVE DESIGN
WATER SYSTEMS
ENERGY ANALYSIS
COST
ARCHITECTURE
PASSIVE DESIGN
WATER SYSTEMS
ENERGY ANALYSIS
COST
EXPERIENCE

Net Zero Energy Usage
Water Use Reduction
Prefabricated Construction
Adaptable Home

Northwestern
McCormick School of Engineering
Modern Healthy Living

Maximum Efficiency
Modern Healthy Living
Maximum Efficiency
Water Use Reduction
Net Zero Energy Usage
Modern Healthy Living
Maximum Efficiency
Water Use Reduction
Net Zero Energy Usage
Prefabricated Construction
Adaptable Home
Meet engiNUity: the team behind NU HOME

The engiNUity team is made up of undergraduate engineering students from various disciplines, all of whom are passionate about sustainable building design.

Andrea Lin
4th Year Undergrad
Environmental Engineering
Minor in Architecture

Bill Yen
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Civil Engineering
Segal Design Certificate

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Thank You!